What Is Claimed Is:

1. A vehicle control system comprising:

a housing;

a sensor cluster within said housing generating a plurality of signals including a roll rate signal, a pitch rate signal, a yaw rate signal, a longitudinal acceleration signal, a lateral acceleration signal, and a vertical acceleration signal;

an integrated controller comprising a sensor signal compensation unit and a kinematics unit, said sensor signal compensation unit receiving at least one of said plurality of signals and compensating for an offset within said at least one of said plurality of signals and generating a compensated signal as a function thereof, said controller generating a kinematics signal comprising a sensor frame with respect to an intermediate axis system as a function of said compensated signal, said integrated controller generating a vehicle frame signal as a function of said kinematics signal;

a dynamic system controller receiving said vehicle frame signal and generating a dynamic control signal in response thereto; and

a safety device controller receiving said dynamic control signal and further generating a safety device signal in response thereto.

2. A system as in claim 1, wherein said sensor cluster comprises at least three angular rate sensors and at least three linear acceleration sensors.

3. A system as in claim 1, wherein said integrated controller further comprises at least one of a reference signal unit generating an attitude reference computation,

a road profile unit generating a road profile signal,

a relative attitude unit generating a vehicle attitude signal with respect to a road,

a global attitude unit generating a vehicle body global angle with respect to sea level,

a directional unit generating a vehicle direction signal,

a directional velocity unit generating a vehicle direction velocities including longitudinal velocity, lateral velocity and vertical velocity signal,

a sensor plausibility unit generating a sensor plausibility signal,

an abnormal state unit generating an abnormal state signal including information regarding abnormal vehicle conditions,

a sensor signal compensating unit generating a mounting sensor error correction signal,

a force and torque estimation unit generating force and torque signal in response to forces and torques applied to the vehicle,

a car body to fixed body unit generating a body fixed to rollover fixed form signal,

a normal loading unit generating a normal loading signal experienced by each tire at each of four vehicle corners, and

a vehicle parameter determination unit generating vehicle parameters ,

wherein said integrated controller generates said vehicle frame signal from at least one of said attitude reference computation, said road profile signal, said vehicle attitude signal, said global attitude signal, said vehicle direction signal, said sensor plausibility signal, said abnormal state signal, said mounting sensor error correction signal, or said force and torque signal.

4. A system as in claim 1, wherein signals generated from said integrated controller used to initiate control commands for various control systems including, but not limited to: power-train controls, brake controls, steering controls, transmission controls, and suspension controls, tire under inflation and unbalanced tires warning systems, on-line conditioning systems, and systems for calibration of errors in sensors due to mounting errors and vehicle loading variations.

5. A control system for an automotive vehicle comprising:

a housing;

a sensor cluster within said housing comprising three angular rate sensors generating angular rate signals and three linear acceleration sensors generating linear acceleration signals, wherein said three angular rate sensors and said three linear acceleration sensors comprise an IMU;

a wheel speed sensor generating a wheel speed signal corresponding to a wheel speed of the vehicle;

a steering angle sensor generating a steering angle signal;

an integrated controller receiving said angular rate signals, said linear acceleration signals, said wheel speed signal, and said steering angle signal, said integrated controller generating an vehicle frame signal as a function of said angular rate signals, said linear acceleration signals, said wheel speed signal, and said steering angle signal;

a vehicle dynamic controller receiving said vehicle frame signal and generating a side slip angle signal as a function thereof; and

a yaw stability control system receiving said side slip angle signal, and a driver's intention signal, said yaw stability control system operating a braking device in response thereto.

6. A system as in claim 5, wherein said vehicle dynamic controller controls vehicle control objectives, such as, but not limited, to yaw stability control, roll stability control, ABS control, traction control, slip control, power-train control, transmission control, drive-train control, suspension control, anti-roll-bar control, vehicle leveling control, fuel economy control, active safety, passive safety, and emission control.

7. A system as in claim 5, wherein said vehicle dynamic controller controls vehicle abnormal state monitoring, including, but not limited to, tire under-inflation detection and monitoring, tire imbalance monitoring and detection, tire wear, steering misalignment, excessive suspension wearing.

8. A vehicle control system comprising:

a housing;

a plurality of input sensors within said housing generating a plurality of signals including a roll rate signal, a pitch rate signal, a yaw rate signal, a longitudinal acceleration signal, a lateral acceleration signal, and a vertical acceleration signal, a wheel speed signal, a steering wheel angle signal, and conditions among calculated signals reflecting a road constraint, a wheel speed alignment, a level ground attitude alignment, and a virtual heading alignment;

an integrated controller comprising a relative attitude determination unit and a sensor misalignment unit, said relative attitude determination unit receiving at least one of said plurality of signals and generating a relative attitude signal therefrom, said sensor misalignment unit calculating sensor misalignments within said plurality of signals and generating a sensor misalignment signal as a function of said sensor misalignments, said integrated

controller generating a vehicle frame signal as a function of said relative attitude signal and said sensor misalignment signal;

a dynamic system controller receiving said vehicle frame signal and generating a dynamic control signal in response thereto; and

a safety device controller receiving said dynamic control signal and further generating a safety device signal in response thereto.

9. The system of claim 8 further comprising a kinematics unit, said kinematics unit receiving said compensated signal and generating a kinematics signal comprising a body frame with respect to an intermediate axis system,

said integrated controller generating said vehicle frame signal as a function of said kinematics signals.

10. A vehicle system comprising:

a vehicle dynamic sensor generating a vehicle dynamic signal;

a wheel speed sensor generating a wheel speed signal;

a steering angle sensor generating a steering angle signal;

an integrated controller comprising:

a sensor signal compensation unit generating a compensated signal as a function of said vehicle dynamic signal, said wheel speed signal, and said steering angle signal,

a kinematics unit generating a signal comprising a sensor frame signal with respect to an intermediate frame as a function of said compensated signal,

a core attitude and velocity algorithm unit

generating core attitude signals including roll and pitch vehicle body attitudes with respect to said intermediate frame and directional velocity signals including at least one of longitudinal velocity, lateral velocity, vertical velocity of the vehicle with respect to an inertial frame as a function of said wheel speed signal, said steering angle signal, and a relative attitude determination signal, and sharing information with said kinematics unit,

a relative attitude determination unit generating said relative attitude signal as a function of said wheel speed signal and said steering angle signal,

a sensor signal to body fixed frame unit generating a body frame signal as a function of said core attitude and velocity signal, said relative attitude signal, and a sensor misalignment signal,

a sensor misalignment unit generating a sensor misalignment signal as a function of said relative attitude signal,

a body to reference unit generating a vehicle frame signal as a function of said body frame signal and said relative attitude signal; and

a vehicle safety system receiving said vehicle frame signal and said body frame signal and activating a vehicle safety device in response thereto.

11. A system as in claim 10, wherein said integrated controller further comprises at least one of a road profile unit generating a road profile signal,

a relative attitude unit generating a vehicle relative attitude signal,

a global attitude unit generating a global position signal,

a directional unit generating a vehicle directional velocity signal,

a sensor plausibility unit generating a sensor plausibility signal,

an abnormal state unit generating an abnormal state signal including information regarding abnormal vehicle conditions,

a sensor signal compensating unit generating a mounting sensor error correction signal,

a force and torque estimation unit generating force and torque signal in response to forces and torques applied to the vehicle,

a transformation unit to transform body-fixed signals to road-frame signals,

a normal loading unit generating a normal load experienced by each vehicle tire, and

a vehicle parameter unit generating a vehicle parameter signal,

wherein said vehicle safety system receives at least one of a plurality of signals including said road profile signal, said vehicle attitude signal, said global position signal, said vehicle directional velocity signal, said sensor plausibility signal, said abnormal state signal, said mounting sensor error correction signal, and said force and torque signal,

and, wherein said vehicle safety system checks said vehicle reference velocity signal with said at least one of said plurality of signals.

12. A vehicle system comprising:

a vehicle dynamic sensor generating a vehicle dynamic signal;

a wheel speed sensor generating a wheel speed signal;

a steering angle sensor generating a steering angle signal;

an integrated controller comprising:

a transformation unit transforming signals defined in a sensor frame to signals defined in a vehicle body frame and generating a body frame signal as a function of said vehicle dynamic signal and a sensor misalignment signal,

a sensor signal compensation unit generating a compensated signal as a function of said body frame signal, said wheel speed signal, and said steering angle signal,

a kinematics unit generating a signal comprising a body frame signal and reference signals with respect to an intermediate axis system signal as a function of said compensated signal,

a core attitude and velocity algorithm unit generating a core attitude and velocity signal as a function of said wheel speed signal, said steering angle signal, and sharing information with said kinematics unit,

a relative attitude determination unit generating a relative attitude signal as a function of said wheel speed signal and said steering angle signal,

a sensor misalignment unit generating said sensor misalignment signal as a function of said wheel speed signal and said steering angle signal,

a transformation unit transforming signals defined in said vehicle body frame to signals defined in another reference frame and generating a vehicle frame signal and reference signals as a function of said core attitude and velocity signal and said relative attitude signal; and

a vehicle safety system receiving said vehicle frame signal and reference signals and said core attitude velocity signal and activating a vehicle safety device in response thereto.

13. A vehicle control system comprising:

an IMU sensor cluster comprising at least three

angular rate sensors and at least three linear acceleration sensors, said sensor cluster generating vehicle dynamic signals including a roll rate signal, a yaw rate signal, a pitch rate signal, a longitudinal acceleration signal, a lateral acceleration signal, and a vertical acceleration signal; and

an integrated controller comprising a plurality of processing units, said integrated controller receiving said vehicle dynamic signals, said integrated controller generating a vehicle frame signal as a function of said vehicle dynamic signals.

14. The system as in claim 13, wherein said estimate of vehicle operation states and said prediction of vehicle operation states include at least one of vehicle global and relative attitudes, vehicle directional velocities, and forces and torques applied to a vehicle.

15. The system as in claim 13, wherein said controller further generates a sensor plausibility check.

16. The system as in claim 13, wherein said controller further monitors the abnormal conditions of the vehicle in motion.

17. The system as in claim 13, wherein said controller further corrects sensor mounting errors of said sensor cluster with respect to said vehicle body.

18. The system as in claim 13, wherein said controller further generates wsa, rca, lgaa or vhaa alignment conditions; and

removes low frequency drift from at least one of said vehicle dynamic signals.

19. A method for controlling a safety device for a vehicle comprising:

generating a roll rate signal;

generating a pitch rate signal;

generating a yaw rate signal;

generating a longitudinal acceleration signal;

generating a lateral acceleration signal;

generating a vertical acceleration signal;

generating a vehicle frame signal and reference signals as a function of said roll rate signal, said pitch rate signal, said yaw rate signal, said longitudinal acceleration signal, said lateral acceleration signal, and said vertical acceleration signal;

generating a dynamic control signal in response to said vehicle frame signal and reference signals; and

controlling a vehicle safety device in response to said safety device control signal.

20. A method as in claim 19 further comprising:

generating an attitude reference computation;

generating a road profile signal;

generating a vehicle attitude signal;

generating a global position signal;

generating a vehicle direction signal;

generating a vehicle directional velocity signal;

generating a sensor plausibility signal;

generating an abnormal state signal including information regarding abnormal vehicle conditions;

generating a mounting sensor error correction signal;

generating a force and torque signal in response to forces and torques applied to the vehicle; and

generating said safety device control signal in response to a combination of said attitude reference computation, said road profile signal, said vehicle attitude signal, said global attitude signal, said vehicle directional velocity signal, said sensor plausibility signal, said abnormal state signal said mounting sensor error correction signal, and said force and torque signal.

21. A method as in claim 19, wherein controlling said vehicle safety device further comprises controlling yaw stability control, roll stability control, ABS control, traction control, slip control, power-train control, transmission control, drive-train control, suspension control, anti-roll-bar control, vehicle leveling control, fuel economy control, active safety, passive safety (airbag deployment), and emission control.

22. A method as in claim 19, wherein controlling said vehicle safety device further comprises controlling vehicle abnormal state monitoring including: tire under-inflation detection and monitoring, tire imbalance monitoring and detection, tire wear detection, steering misalignment detection, brake pad wear, and suspension wear.

23. A method for controlling a safety device for a vehicle comprising:

generating a roll attitude angle of a sensor frame with respect to an intermediate axis system;

generating a pitch attitude angle of said sensor frame with respect to said intermediate axis system;

generating an x velocity component of said sensor frame with respect to said intermediate axis system;

generating a y velocity component of said sensor frame with respect to said intermediate axis system;

generating a z velocity component of said sensor frame with respect to said intermediate axis system; and

transferring said roll attitude angle, said pitch attitude angle, said x velocity component, said y velocity component, and said z velocity component in said sensor frame to a body fixed frame of reference system as a function of sensor misalignments.

24. The method as in claim 23 further comprising generating wsa, rca, lgaa or vhaa alignment conditions; and

removing low frequency drift from within at least one vehicle sensor signal.

25. A method for controlling a safety device for a vehicle comprising:

transforming vehicle dynamic variables from a sensor frame to a body frame as a function of vehicle dynamic sensor misalignments;

generating a roll attitude angle of said body frame with respect to an intermediate axis system;

generating a pitch attitude angle of said body frame with respect to said intermediate axis system;

generating an x velocity component of said body frame with respect to said intermediate axis system;

generating a y velocity component of said body frame with respect to said intermediate axis system; and

generating a z velocity component of said body frame with respect to said intermediate axis system.

26. The method as in claim 25 further comprising generating wsa, rca, lgaa or vhaa alignment conditions; and

removing low frequency drift from within at least one vehicle sensor signal.